Space Weather Technical Forecast

Issued on Sunday, 14 July 2024 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-Class flares expected (R1-R2 Blackouts)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High with up to ten M-class flares and one X-class flare. The majority of these, including the X1.2 at 14/0234 UTC, were from AR3738. There are twelve sunspot regions on the visible disc. The most active is the aforementioned AR3738 in the southwest. This is a relatively large region, with a number of dark umbrae but a rather open structure with multiple delta structures. AR3751 in the southeast is becoming increasingly clear, with moderate size and complexity currently visible. AR3743, just east of the south-centre disc, and AR3744 have shown small changes, though both contain an element of unstable north-south aligned spots of opposite polarity. All other spots are smaller and simple.

Despite the number of solar flares, no Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Slow wind conditions dominated the solar wind environment. Observed speeds at ACE persisted at background 300-350 km/s, while the density remained below or near average. Total Interplanetary Magnetic Field, Bt, was weak, below 8nT, with the north-south component, Bz, weak and variable, between -4nT and +3nT. Phi angle was largely negative (towards the Sun), but with periods of positive (away from the Sun) after 14/0400 UTC. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The 24-hour fluence was below Active, with 1.51e6 integrated pfu observed at 14/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are expected, with a slight chance of further X-class flares, most likely from AR3738.

Solar Wind /Geomagnetic Activity: There are no Earth-directed CMEs. Initial slow wind conditions may be followed by a slight enhancement due to the onset of the fast winds from CH52 on day 1 (14 Jul). Any enhancement then easing later day 2 (15 Jul) onward. Mainly Quiet geomagnetic activity expected, with isolated Unsettled intervals. Any fast wind enhancement on day 1 into day 2 (14-15 Jul) will bring a likelihood of an Unsettled to Active spell and a slight chance of G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background levels, but with a chance of rising in response to any notable flares, mainly from AR3738. High energy Electron flux is expected to persist at background at first, with a chance of rising to Moderate or perhaps briefly High later in the period in response to any fast wind enhancement on day 1 (14 Jul). The associated 24 hr fluence is expected to persist below the Active threshold (1e8 integrated pfu).

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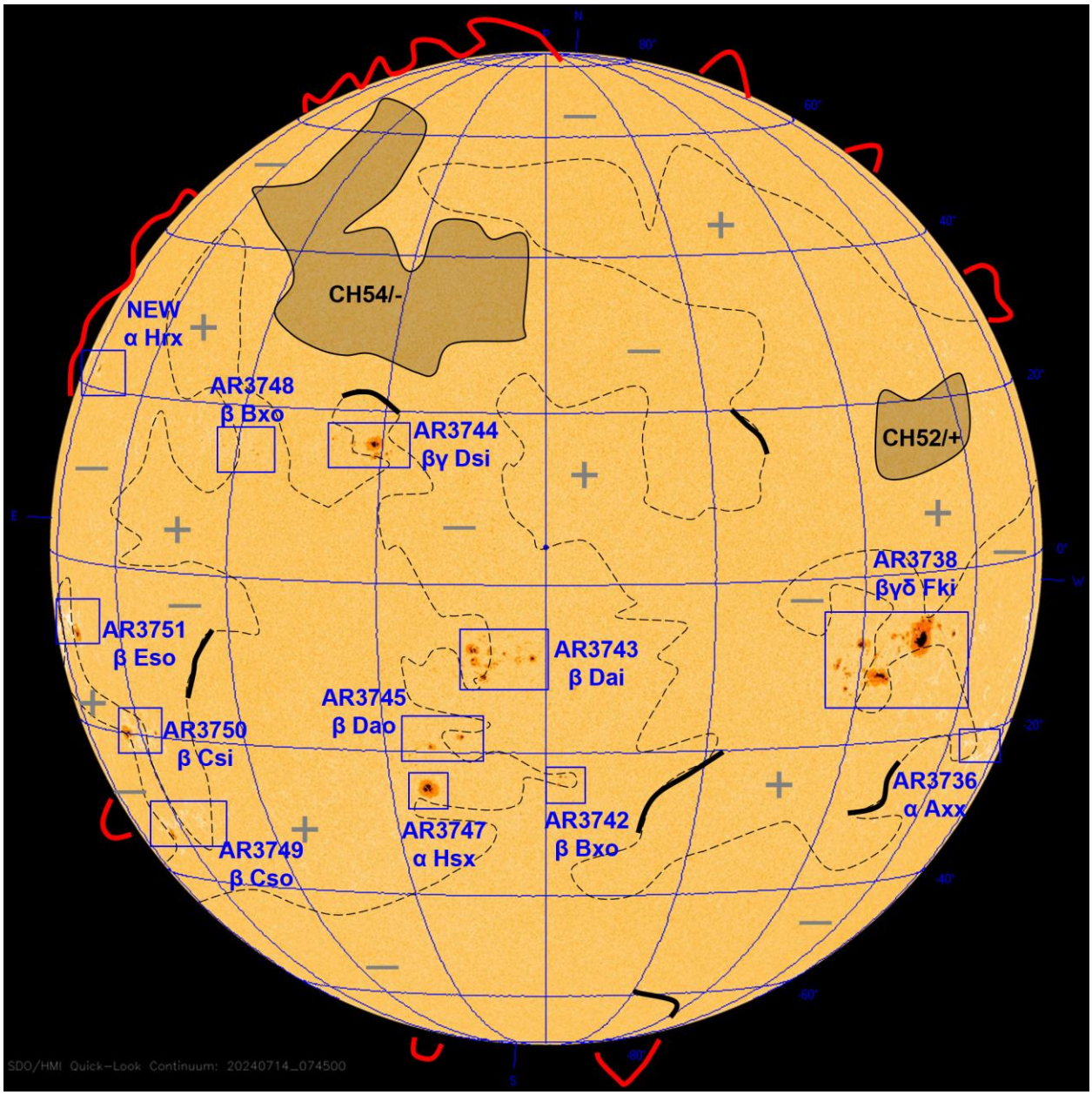
Figure 1. Solar Analysis Valid 14/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

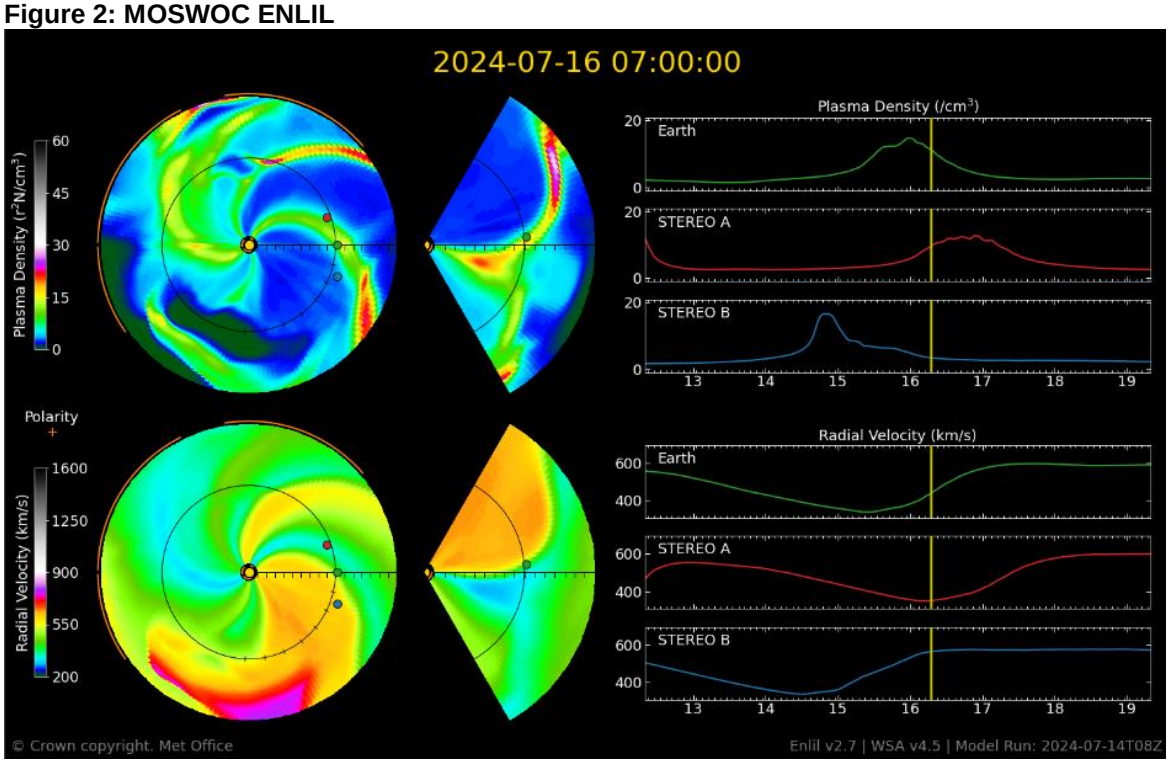
There are no Earth-directed CMEs.

The anticipated enhancement from the arrival of CH52 fast wind has yet to occur, suggesting any increase to solar winds is likely to be weaker than originally anticipated, perhaps rising to around 450km/s later on day 1 (14 Jul). This remains low confidence however, with MOSWOC Enlil currently providing poor guidance due to over-estimating the enhancement from a pair of coronal holes on the southwestern disc that was not observed. This will bring a likelihood of Unsettled to Active intervals later day 1 into day 2 (14-15 Jul) with a slight chance of G1 Minor Storm intervals.

Any fast wind enhancement will then ease later day 2 onward (15 Jul) with mainly Quiet to Unsettled geomagnetic activity following.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



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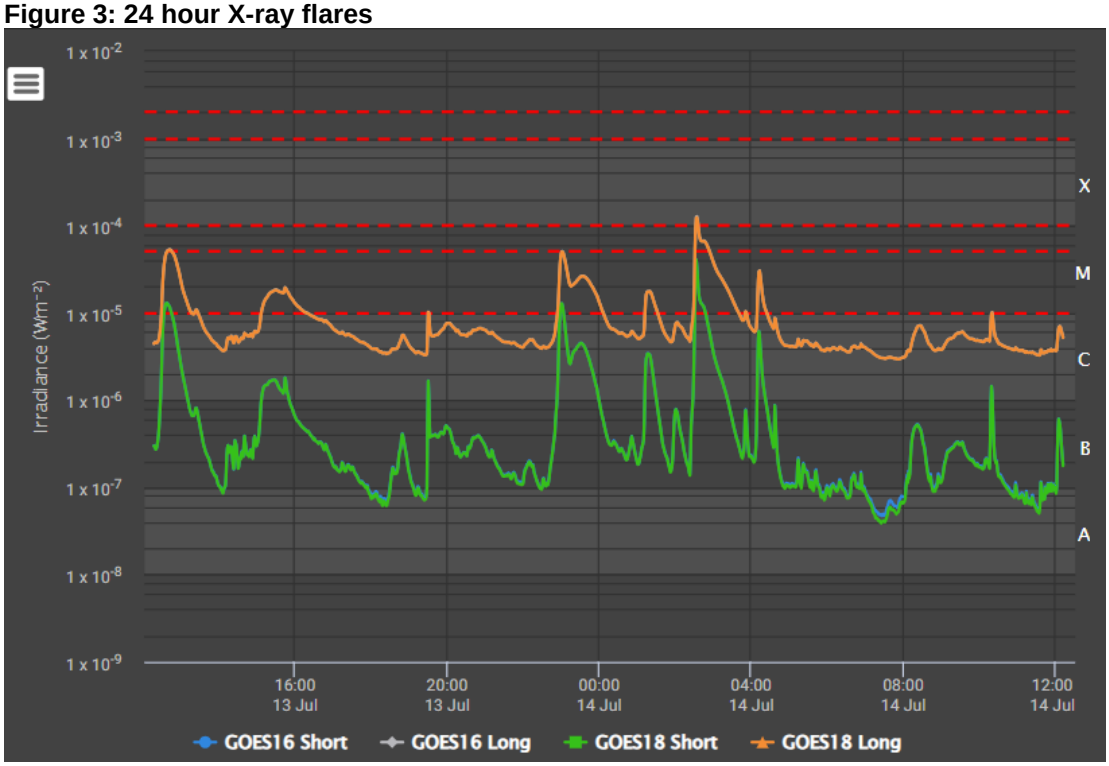
Radio Blackouts - X-Ray Flares:

Activity is expected to be mainly Moderate, with further M-class flares, and a slight chance of further X-class flares. The more intense flares are most likely from AR3738, but there is a potential for some flare activity from across the other regions currently on the disc.

There are twelve sunspot regions on the visible disc. The most active is AR3738 in the southwest. This is a relatively large region, with a number of dark umbrae but a rather open structure. The main negative leader spot has seen flux emergence continue to its northwest, including the development of a weak delta configuration, and has been the source point for much of the flare activity from the region. However the X1.2 flare appears to have originated from a further large negative umbra in the south of the region, which also has a weak delta configuration. AR3751 on the southeast is becoming increasingly clear, this region appears bright on SDO aia-94, with moderate size and complexity currently visible, though will become increasingly clear as it rotates into a less oblique viewing angle in coming hours. AR3743, just east of the south-centre disc, and AR3744 have shown small changes, though both contain an element of north-south aligned spots of opposite polarity. All other spots are smaller and simple.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: 24 hour X-ray flares



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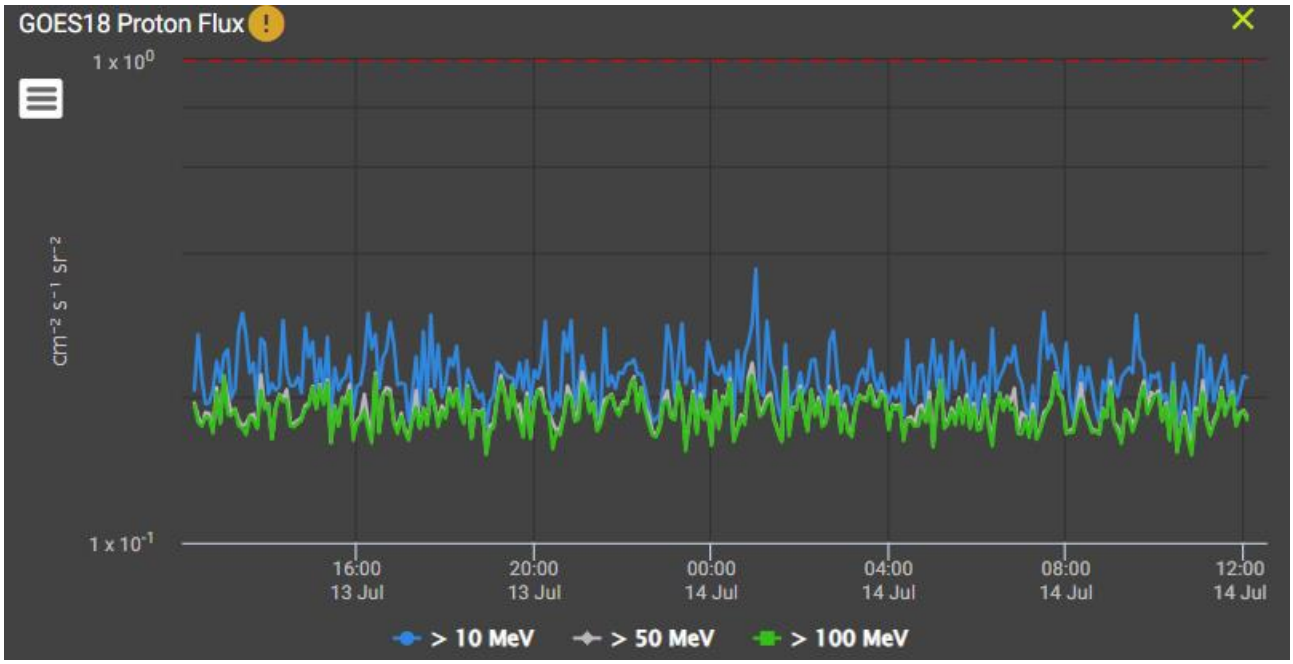
Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at Background. It is most likely to remain at background, but with a slight chance of exceeding the S1/Minor radiation storm threshold should any significant flares occur, these perhaps most likely from AR3738.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES 18 proton flux



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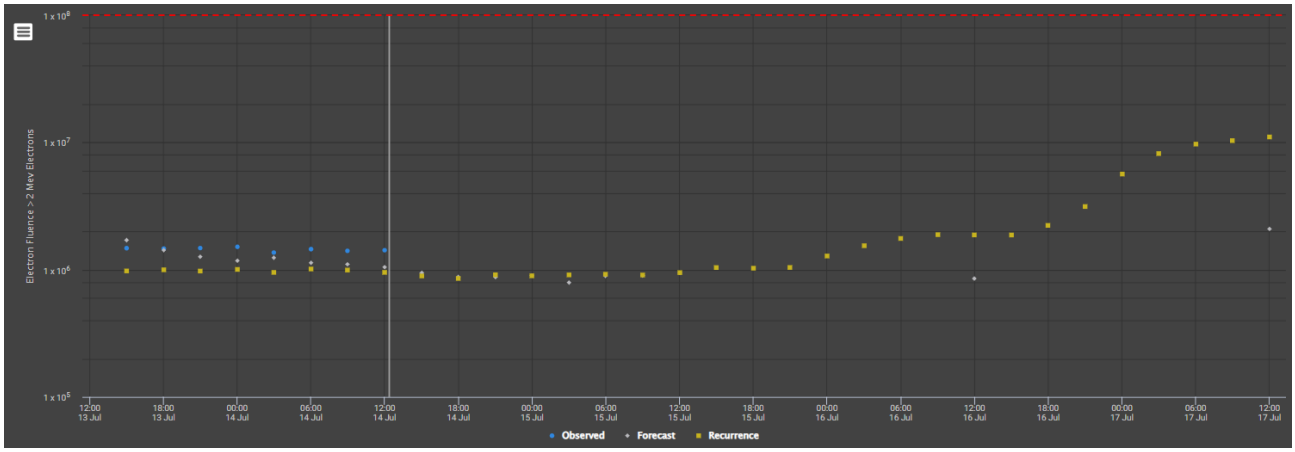
High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at Background, but is likely to see a modest increase later in the period due to the expected fast wind enhancement from CH52/+. This is expected to occur later day 1 (14 Jul), with any fast wind influence then easing day 2 (15 Jul onward). Moderate high energy electron flux is then likely, with a slight chance of reaching High later in the period.

The associated 24 hour fluence is expected to remain below the Active threshold however, with only a very slight chance of rising above from late day 2 onward. REFM is currently providing good guidance, at least for day 1 and into day 2 (Jul 14-15). Confidence in the REFM forecast then falls due to any potential fast wind enhancement.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM electron fluence observations/forecast/recurrence.



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